ADVENTURES OF THE MIND 18.

The Earth's Shifting Crust

By CHARLES H. HAPGOOD

Science may be about to rewrite the story of the earth. Geophysicists and geologists are currently examining with new interest the startling idea, first advanced in the nineteenth century, that the earth's crust may be loose and that from time to time forces may cause it to slip over the layers below. Such crustal shifts would literally change the face of the earth, subjecting the areas affected to climatic changes that would determine the fate of all living things.

It has recently become apparent that many of the established and hitherto accepted principles of geology are not leading us to a solution of the basic problems of the earth. The assumption of crustal displacements provides many of the answers for which science has long been searching.

I shall summarize these problems and the evidence for such continuing shifts, and present a theory—worked out in collaboration with James H. Campbell—to account for these shifts.

One of the long-standing mysteries of the earth is the origin of mountains. It was originally suggested that mountains could be explained by the cooling and shrinking of the earth, in the same way that an apple, as it dries up and shrinks, produces skin wrinkles. However, Clarence Dutton, the geologist, pointed out more than forty years ago that this would not explain mountains. He showed that the patterns of folding that would result from such shrinking, if it really occurred, would bear no resemblance whatever to the patterns of existing mountain ranges. He pointed out that in that case the ranges would run in all directions and would not form long, narrow belts such as the Appalachians, the Rockies or the Andes. Nobody was ever able to contradict Dutton. Geologists now agree that the force responsible for the folding of the rock strata did not operate in all directions on the earth's surface, but was exerted horizontally as a *CONTINUED ON PAGE 66*

About the Author

Charles H. Hapgood, a graduate of Harvard College, the Harvard Graduate School of Arts and Sciences and the University of Freiburg, has specialized in intellectual history and, during recent years, the history of science. Professor Hapgood is associate professor of history and anthropology at Keene Teachers College in New Hampshire.

James H. Campbell, who has collaborated with Professor Hapgood on the crustal-shift theory, is a mathematician, chemist and electrical engineer. Mr. Campbell built the first model of the Sperry Gyroscopic Compass, worked closely with George Westinghouse and collaborated with Fessenden in the development of wireless telegraphy. Mr. Campbell is now eighty-five years old.

The theory developed by Messrs. Hapgood and Campbell was presented at length in their book, Earth's Shifting Crust. Photograph by Ollie Atkins

The Earth's Shifting Crust

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thrust in one direction. But a satisfactory explanation of such pressures has never been found.

Volcanoes are phenomena often associated with mountains. Many mountains, and even whole island systems, have been built up by volcanic action. But to this day there is no generally accepted theory of volcanism. There is no agreement as to the source of the magma—the molten rock—that fills thousands of cracks and fissures in the earth's crust, and occasionally erupts at the surface.

Another open question about the earth's crust is whether the present continents and ocean basins have been permanent features of the earth's surface. There is a vast amount of geological and biological evidence for former land connections between the continents, for "land bridges," but there has been no way of explaining their appearance and disappearance.

If we turn to the history of climate, we find other unsolved problems. More than 100 years ago geologists made the discovery, which at first appeared unbelievable, that floods of ice had in the past swept down over great areas of North America and Europe, invading the temperate zone. Since that time at least fifty theories have been produced to explain these ice ages, but none of them has been satisfactory.

One of the special mysteries connected with ice ages is the location of former icecaps on the earth's surface. Theoretically, one would expect a great ice sheet to spread out in all directions from a center at or near one of the poles. But it appears that the last North American icecap had its center two thousand miles south of the North Pole, and spread northward as well as southward and westward. Long ages ago another great ice sheet had its center in the African Congo, on the equator. Still another formed in Southern India, and may have spread southward to the equator on land now under the Indian Ocean. These facts have defied explanation.

The reverse climatic situations are equally inexplicable. There have been many cases of warm, temperate climates prevailing near the present poles. Luxuriant forests have existed in areas now terribly cold—in Spitsbergen and on Bear Island in the Arctic Ocean, and on the lofty sides of Mount Weaver, within two hundred miles of the South Pole.

These climatic puzzles are connected with unsolved problems in the theory of evolution. It is still widely supposed that the principle of natural selection explains the origin of new forms of life. The truth is, on the contrary, that the impossibility of explaining evolution through natural selection, without the assistance of some other factor, became obvious to geneticists about the year 1900. Statistical studies by J. B. S. Haldane and others showed that the amount of time that would be required for new traits to become established in a species by natural selection alone was so immense that even whole geological periods would not suffice to produce new species. As a way out of the difficulty it was suggested that mutations might account for more rapid changes in life forms. It soon became evident, however, that the very great majority of all mutations, since they are random, must be harmful and will be eliminated, in due course, by the process of natural selection itself. The net result of mutations, therefore, must be to slow down, rather than to accelerate, the process of evolution.

The time element is by no means the only problem left unsolved by evolutionary theory. Another is the frequent recurrence through the earth's history of simultaneous extinctions of many forms of life, with whole groups of species succumbing together. In many cases paleontological evidence shows that these species did not succumb to the competition of superior forms, but left their life zones empty—or were succeeded by inferior species.

One of these periods of wholesale destruction of life occurred at the end of the last ice age. At that time the mastodon and the mammoth, the giant beaver, the giant sloth, the saber-toothed tiger, and many other species, were destroyed, while others (like the horse in North America) were displaced from their original habitats and driven to the ends of the earth. It was a natural disaster which, according to one writer, destroyed some 40,000,000 animals in North America alone. And this occurred when the climate was improving—at the end rather than at the beginning of the ice age. In a few thousand years life on earth assumed a radically new aspect. There has been no acceptable explanation of this.

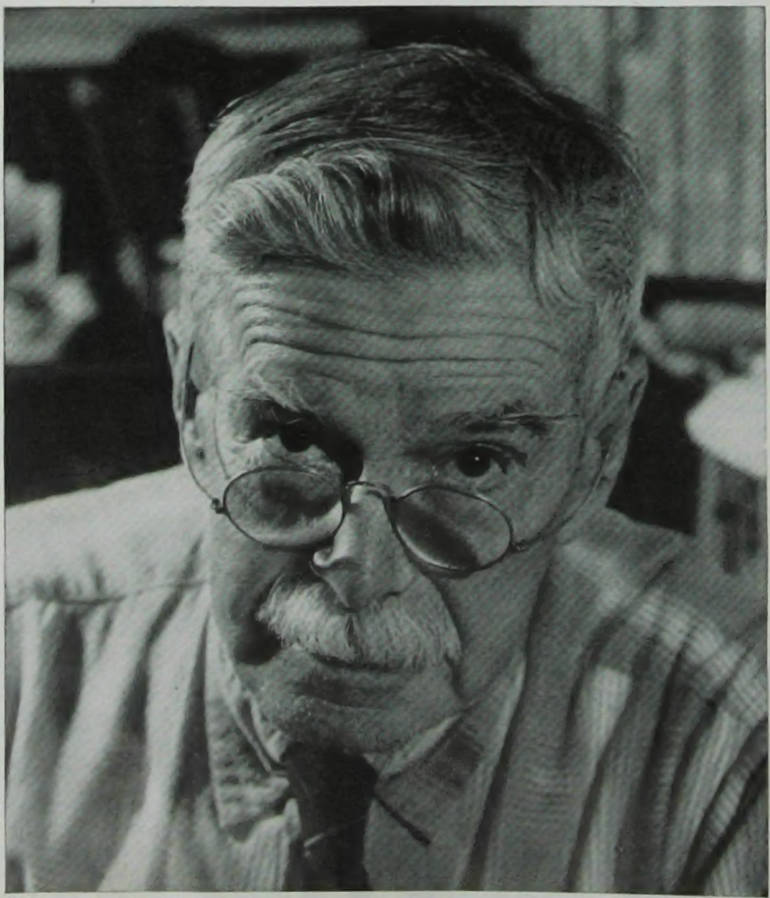
One of the most astonishing facts of this mass destruction of animals is the complete preservation of the remains of many of them in the frozen ground of northern Siberia and Alaska. For many centuries mammoth tusks in huge numbers have provided a supply for the ivory trade in China. Bodies of mammoths have been found so completely preserved that their meat has been edible. Summer flowers and grasses have been found, almost perfectly preserved, in their mouths and stomachs.

It is apparent that millions of animals once flourished in areas now bitterly cold. Furthermore, there is plentiful evidence that the bodies of hundreds of thousands of animals of all kinds were entrapped in the great ice sheet that covered so much of North America in the last ice age. There was thus tremendous mortality at the beginning of the ice age as well as at the end. How did animals of a temperate climate become entrapped in the mile-thick ice sheet in North America? What sequence of events preserved the Siberian and Alaskan animal remains at a later period—for it is known that ivory, as well as meat, changes its structure rapidly if exposed to the air at normal temperatures?

These circumstances require an agency that can change climate rapidly, and not merely over extended periods of time. A shift of the crust of the earth can provide both gradual and abrupt climatic changes, for the reason that it must inevitably set up intense strains and stresses in the crust. These strains can be expected to increase the rate of volcanic eruptions, in which vast quantities of volcanic dust will suddenly cloud the earth's atmosphere. The meteorologist, Humphreys, showed years ago that one great eruption (that of Mount Katmai in Alaska in 1912) temporarily cut off 20 per cent of the sun's radiant heat from the earth's entire surface.

We can thus hazard that the mammoths were killed by deep snowfalls and buried in freezing mud following a sudden and catastrophic weather change caused by some distant volcanic holocaust and its proliferating dust. We may further suppose that many of the animals were preserved for thousands of years because the area in which they lived was then being shifted poleward by the moving crust.

With regard to the last ice age, we have recently come into possession of new information that deepens its mystery. Since World War II new methods of dating geological events have been made available through nuclear physics. One of these uses a radioactive isotope of carbon (Carbon 14) and is able to date geological events of the last 30,000 years with considerable accuracy. Another, using three radioactive elements found in sea water, gives dates for the last million years. By use of the first method, scientists revised the date of the end of the last ice age, making it only 10,000 years ago, instead of 30,000 years. A still more startling discovery was that the first known phase of this ice age (called the "Farmdale Advance") occurred only about 25,000 years ago, instead of more than 100,000 years before the present.



James H. Campbell, a prominent inventor, chemist and engineer, helped formulate Hapgood's new theory of earth-crust movement.

This discovery challenged the fundamental principle of the system established by the nineteenth-century geologist, Charles Lyell. He supposed that geological processes in the past always proceeded at their present rates: processes such as rainfall, snowfall, erosion and the deposition of sediment. However, in 1955, geologist Leland Horberg showed that, unless the radiocarbon method was entirely fallacious, there was a very marked acceleration of the rate of these geological processes during the last part of the ice age. Some factor must, therefore, have been operating that is not operating now. It is clear that volcanic dust, by producing sudden falls in temperature and, at the same time, providing nuclei around which moisture could condense, could increase the rate of rainfall. Therefore, we are sure that a movement of the earth's crust would accelerate all these processes.

The other new method of dating, which we call the ionium method, has also produced a major upset. Applied to date the sediments obtained in cores from the bottom of the Ross Sea in Antarctica, it has revealed that during the last million years Antarctica has several times been nonglacial. When these cores were dated it was found that the most recent "ice age" in the Ross Sea began only 6000 years ago! It appears from this that the growth of the ice in Antarctica actually occurred simultaneously with the melting of the North American icecap. I had the opportunity to discuss this matter with Einstein, and he expressed his opinion that only a shift of the earth's crust, simultaneously moving North America away from the North Pole and Antarctica toward the South Pole could explain these facts.

The importance of all these problems compels us to admit that we do not now have an integrated, effective theory of the earth we live on. If we are going to look for a better understanding of it, we must turn to one of the basic principles that underlie the sciences and that have enabled people to surmount crises of science in the past. This is the principle of simplicity. In the history of science we see how again and again, a new basic solution has taken the form of some simple idea, an idea that made it possible to relate many different problems and explain them simply.

To accomplish this we looked for a common factor linking the different, apparently separate, problems. The key to the theory was the discovery of this common denominator. In our examination of geological literature we found that there was one conjecture that kept cropping up in controversies about earth problems. Sooner or later, it was always suggested that the problem under discussion might be solved if we assumed shifts of the earth's poles. These suggestions were always dismissed, however, because no one could explain how the poles could be shifted.

My collaborator and I have now produced a new theory of polar shift. We have taken the old idea that the earth's crust can be shifted, thus changing the

geographical locations of the poles, and we have added to this an idea we borrowed from the noted engineer, Hugh Auchincloss Brown, to provide a force for moving the crust. In two ways this theory is in accord with the principles I have mentioned: It is based on a few simple assumptions, and it appears able to explain and integrate many questions.

Let me define our assumptions. The earth is thought to be composed of an inner liquid core, made up of either iron or of rock materials under great compression, with a radius of about 2000 miles. Around this core are three layers. The lowest and thickest of these is called the mesosphere, meaning "middle sphere." This is a solid shell, several hundred miles thick, kept solid by the pressure at that depth. The shell about this is called the asthenosphere, from the Greek word for weakness. This, supposedly, is a viscous and plastic layer with little or no strength. Its thickness is uncertain. It is overlain by the earth's crust, from twenty to forty miles thick. Our first assumption is that the crust can be displaced over this weak layer. The deeper shells of the earth are not involved.

This assumption is supported by a mass of geophysical evidence. The late Prof. Reginald A. Daly pointed out that the temperature of rocks observed in mine shafts and oil wells increases with depth, and that this leads to the conclusion that at some point between twenty and forty miles below the surface the rocks must reach their boiling points. This would mean that their crystalline structure would be destroyed, and we know that the strength of rocks depends upon their structure of interlocking crystals. The asthenosphere, in Daly's estimation, must then yield easily to any pressure exerted over a prolonged period of time. Daly maintained that only a weak layer below the crust could explain volcanic action or make possible the folding of mountains. He pointed out that in mountain building the crust folds to its full depth, and that this must require considerable horizontal shearing movement of the crust over the asthenosphere, a movement that would be impossible if the sublayer had any strength.

Einstein on Hapgood's Theory

• During an early period of his work on the shifting-crust theory Professor Hapgood outlined his findings to Albert Einstein. Excerpts from Professor Einstein's answering letter follow:

"I find your arguments very impressive and have the impression that your hypothesis is correct. One can hardly doubt that significant shifts of the crust of the earth have taken place repeatedly and within a short time. The empirical material you have compiled would hardly permit another interpretation.

"It is certainly true, too, that ice is continually deposited in the polar regions. These deposits must lead to instability of the crust when it is sufficiently strong not to constantly keep in balance by the adjustment of the polar regions.

"The thickness of the icecap at the polar regions must, if this is the case, constantly increase, at least where a foundation of rock is present. One should be able to estimate empirically the annual increase of the polar icecaps. If there exists at least in one part of the polar regions a rock foundation for the icecap, one should be able to calculate how much time was needed to deposit the whole of the icecap. The amount of the ice that flowed off should be negligible in this calculation. In this way one could almost prove your hypothesis.

"Another striking circumstance appears in connection with the ellipticity of the meridians. If, according to your hypothesis, an approximate folding of the meridional volume takes place . . . this event will have to be accompanied by a fracture of the hard crust of the earth. This also fits in very well with the existing phenomena of the volcanic coastal regions with their mainly north-south extension and the narrowness in the east-west direction. Without your hypothesis one could hardly find a halfway reasonable explanation for these weak spots of the present-day crust of the earth. . . ."

Perhaps the most important argument advanced by Daly for a weak asthenosphere was that this alone would make possible the observed degree of gravitational balance of the crust. Geologists use the term isostasy to refer to this principle of balance. According to this principle, if a sector of the crust becomes overloaded with sediment (or ice) it sinks until it reaches gravitational balance. It is like an iceberg sinking into water to reach equilibrium. The sectors of the earth's crust are in this sort of hydrostatic equilibrium, more or less, but the erosion, deposition of sediment, accumulation of icecaps, volcanic action, and other factors, force constant readjustment. This readjustment requires that plastic rock under the crust must flow from the overloaded regions to the unloaded regions. This flow would obviously be impossible if the rock had much strength. Thus, the whole theory of isostasy depends upon a weak asthenosphere. There is, therefore, good reason to take our first assumption seriously.

The problem of a force to move the crust was solved through the suggestion made by Brown. He pointed out that in engineering it is highly important to center a rotating flywheel accurately, because if it is off-center there will be a disruptive centrifugal effect—a sidewise heave so powerful that it may shatter the flywheel. Now, said Brown, if we look at the earth, we find that an off-center weight has accumulated at one point on it: namely, at one of the poles, where we find the Antarctic icecap. This icecap, he pointed out, covers about 6,000,000 square miles and is thought to average a mile in thickness. This makes for a very formidable weight indeed, twenty-five quadrillion (25,000,000,000,000,000) tons! Our measurements indicate that the center of this enormous mass is about three hundred miles from the pole, so that it is not centered at the axis of rotation, and a centrifugal effect must result.

When I consulted Professor Daly, and the physicist, Prof. Percy W. Bridgman, at Harvard, about this idea of Brown's, they agreed it was a good one, Professor Daly, however, said that it was an idea that had never been investigated by

science, and his statement was later supported by Harvard's great historian of science, the late Dr. George Sarton.

In order to apply this principle of centrifugal effect to the icecap we had to make our second assumption. For our theory to be valid, it was necessary that the icecap should have accumulated faster than the crust could sink under it. The reason for this is that if the crust should sink as fast as the snow accumulates on an icecap, then no surplus weight will be created on the crust to exert a centrifugal effect. Fortunately, geologists agree that icecaps have accumulated faster than the crust of the earth can give way. A lag results, partly from the resistance of the crust, which has some strength, and partly from the stiffness of the viscous rock under the crust, which takes time to flow out from under the area where the icecap is accumulating. Our second assumption, therefore, appears to be strongly based.

Let us now test our theory by what it is able to explain.

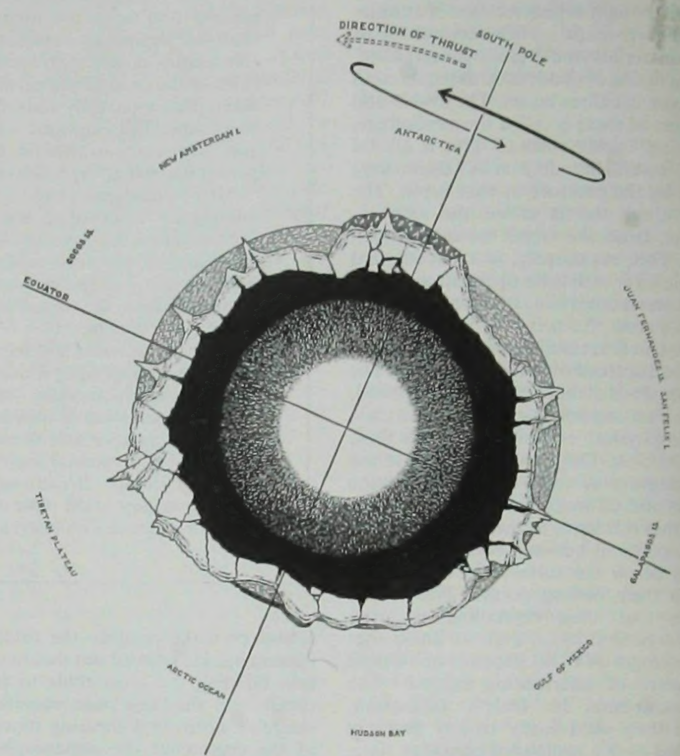
First, the theory provides us with a reasonable explanation of the folding of the mountains and for volcanic zones. The earth is oblate—or flattened at the poles—so that the difference between its diameter through the poles and through the equator is about twenty-six miles. This means that if a section of the crust is moved poleward it will be slightly compressed and must fold, while one moved equatorward will be stretched and must crack. Volcanoes will tend to form along such cracks, which in some cases may become volcanic zones. Mr. Campbell has shown that in areas of compression the patterns of folding to be expected from a crust displacement agree closely with those of existing mountain ranges.

The theory that accounts for mountain building also, of course, accounts for land bridges between continents, for a mountain range formed on the bottom of a shallow sea might well create a land bridge between two land masses. A subsequent movement of the crust might later destroy the land bridge, by moving the sector equatorward. In this case there would be subsidence of the land relative to sea level.

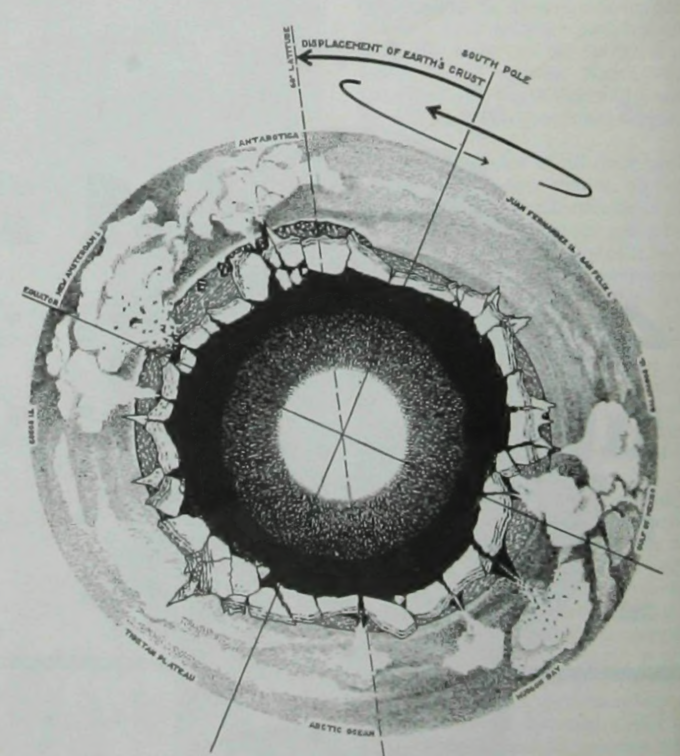
When it comes to ice ages, the assumption of crust displacements makes it easy to explain the wrong location of past icecaps, including those that once existed in the tropics. The theory explains them by assuming that these areas were formerly located near one of the poles, and that later movements of the crust shifted them away. The same assumption also explains former warm climates at the poles. Furthermore—and this is most important—the theory explains the acceleration of the rates of geological processes at the end of the last ice age, on the assumption that a crust in movement will produce turbulent conditions on the earth's surface.

With regard to evolution, the theory supplies the missing factor, a factor to accelerate the process. Biologists have always recognized that the most powerful evolutionary force must be climatic change. The trouble, hitherto, has been that climatic change has supposedly occurred too slowly to account for the quantity of evolutionary change. Now, if our theory is correct, the rate of climatic change is suddenly multiplied five or ten times. Our evidence indicates three displacements of the earth's crust in the last 150,000 years. If we are correct, this must have involved great pressure on plants and animals to adapt to changing conditions. It can also explain the extinctions of species unable to adapt or to migrate.

Oddly enough, our theory even seems to throw some light on the affairs of our sister planet, Mars. Dr. Harold Urey, in his book, The Planets: Their Origin and Development, notes that Mars has no mountains on its surface. Likewise, it has no icecaps, except for thin layers of hoarfrost around the poles in winter. Otherwise, the composition of Mars closely resembles that of the earth. The absence of great icecaps, of course, is due to the lack of water, but could there not be a relationship of cause and effect here; no great icecaps, therefore no crust displacements, therefore no folded mountains?



Cross section of the earth. The mound at top is the Antarctic icecap, a tremendous weight which (1) creates a centrifugal force that unbalances earth rotation and (2) exerts pressure on the earth's crust and its weak underlayer.



As the layer (black band) under the earth's crust gives way, the icecap shifts. The force of this great, relatively quick movement would cause compensating changes—in animal life, land and climate—throughout the world.

There are special reasons for insisting that icecaps are the most likely agents for causing crust displacement. In the first place, they provide a mechanism that can overcome friction in the sublayer and can displace the crust to very great distances. This is the result of the fact that the centrifugal effect increases mathematically with increased distance of the center of the icecap from the pole (or rather from the axis of rotation). The icecap is rotating with the earth on an ever-increasing radius of eccentricity. Therefore, the force builds up and can never be absorbed by friction.

This is not enough, however. We have to explain not only how the crust could be displaced to great distances but also what factor limited the displacements to a fraction of the total distance from pole to equator. According to mechanical principles, the centrifugal effect would not decline until the excess weight on the crust that caused it approached the equator. The geological evidence, however, suggests that the latest movement of the crust stopped when Hudson Bay (which theoretically lay at the pole during the last ice age) had been moved only one third of the way to the equator. We must, therefore, have a weight that will disappear en route. Ice is the only sort of material that can disappear with its job one third done—by melting in the temperate zone!

Any new theory can, of course, be expected to encounter objections. We have encountered many of them in the last few years, and I have answered a good many of them in our book. One of the most troublesome Mr. Campbell and I have encountered is the question: What if both poles happen to be located in oceans? Won't the process of displacement then stop, since no thick icecaps can form in water?

This objection became less formidable as we investigated it. First, Mr. Campbell showed through a map study that because of the way the continents are placed it is almost impossible for both poles to be located in water areas and far enough away from the nearest land mass so that no icecaps can form. Then, my work showed that as a water area is moved poleward, the sea bottom rises relatively to sea level, and in many, if not most, cases the uplift would be sufficient to bring it to the surface. Finally, in my own investigations of the geological record I have found that changes at short intervals drastically affecting conditions on the earth's surface, and explainable by crust displacements, have been a feature of most geological periods.

Another frequent inquiry is: What of the future? It is reasonable to suppose that if there have been crust displacements in the past there will be more in the future. Our calculations suggest that the Antarctic icecap is nearly large enough now to start a movement of the crust. If that turns out to be correct, then mankind will have to divert its attention from destructive conflict long enough to control the icecap.

There have been a few earthquakes, notably the 1950 earthquake in Assam and the vast upheaval in December, 1957, in Mongolia, that suggest the imminence of a new displacement. If and when such a movement does start, we have a basis for an educated guess as to its likely direction. From the location of the Antarctic icecap's center of gravity, at latitude 85 south and longitude 96 east, we can deduce the direction of thrust of the icecap. This will determine the direction in which the crust moves. The ninety-sixth meridian bisects central North America, the Pacific west of South America, Antarctica and East Asia. From the direction of the present thrust in this meridian we expect that the next movement will pull the Western Hemisphere southward (in very much the same direction in which it apparently traveled last time) and push the Eastern Hemisphere northward. We may then expect that an icecap will form in Siberia, and that many species of animals in India, having no land to the south to escape to, will become extinct. The United States, moving into the semitropics, will subside relatively to sea level, perhaps a thousand feet or so. However, besides being necessarily somewhat doubtful, these disagreeable prophecies will not be realized for a long time, for our movement, once it starts, will require many thousands of years for its completion.

Readers interested in knowing more about the crustal-shift theory are referred to:

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So You're Flying Jet to Europe (Continued from Page 15)

about $16,000 per trip. In a month's time one such plane making a round trip to Paris every twenty-four hours could show an operating profit of almost $1,000,000. The net profit, of course, would be much smaller.

My jet flight to Paris began at a familiar portal, the dingy, crowded "temporary" Pan American departure terminal at New York International Airport—Idlewild—where in the jet age the struggle for a place at the ticket counter and, later, at the seat-assignment counter, is worse than ever.

A Pan American official informed me that the company was moving at near supersonic speed to improve its ground operations. Under construction at Idlewild, and scheduled for completion next fall, is a futuristic $8,000,000 jet-age departure terminal. It will have high, cantilever roofs, under which planes can park when it is raining or snowing; a total of forty-eight check-in counters, all within a stone's throw of the plane itself, and a five-minute maximum wait for baggage (it says here). The terminal is designed to load or unload one 165-passenger jet liner every fifteen minutes. American Airlines is building a similar terminal at Idlewild at a cost of $14,000,000.

Our flight was called—Pan American 114, scheduled to depart every evening at seven P.M.—and, after a long hike through the sheep run, we reached the airplane loading area. There, bathed in floodlights and looking like something out of a press agent's dream, was a Boeing 707, the first United States jet transport to go into regular service and, until the Douglas DC-8 is certified, the work horse not only for Pan American but domestic airlines as well. Like the other passengers around me, I stared transfixed. Squatting on its ten giant wheels, the blue, white and silver swept-wing plane looked twice the size of the DC-7C, one of the largest propeller-driven transports in service.

The 707 is a $5,500,000 civilian version of the Air Force's KC-135, which in the last three years has logged more than 50,000 flying hours as an aerial tanker-transport. Nearly 200 KC-135's have been delivered to the Air Force. Only two have crashed. One accident was laid to pilot error; the other is still under investigation.

The first 707 flew in July, 1954. Made cautious by the series of accidents which befell the original British Comets, the Civil Aeronautics Administration was severe in its inspection. Pan American and Boeing test-flew the 707 more than 1000 hours under every conceivable condition. Afterward the plane was systematically destroyed to measure its ability to withstand severe stress. The 707 is called "the most thoroughly tested civilian transport ever put in service." This is no exaggeration.

Looking at its massive bulk on the ground, one wonders how it could ever fly. The fuselage is nearly half the length of a football field—144 feet, six inches—longer by twenty-four feet than the ground covered by the first flight of the Wright brothers. Its tail towers to nearly four stories—thirty-eight feet, three inches. Its wings, angled back at thirty-five degrees, are about the same span as the DC-7C—130 feet, ten inches—but the four jet pods hanging beneath them make the plane seem heavier and bulkier. Fully loaded the plane weighs 123 tons, or about fifty-two tons more than a DC-7C. The fifty-four small windows along each side of the fuselage give the 707 a vague resemblance to a landlocked ocean liner.

"As a matter of fact," a Pan Am executive said, "one of these planes making a round trip every twenty-four hours could carry more people back and forth across the Atlantic than the Queen Mary."

One appealing feature of the 707 from the airline point of view is the flexibility of the seating arrangement inside its 100-foot-long cabin. All seats are mounted on tracks and can be changed around swiftly to accommodate the four classes of air travel: de luxe, first class, tourist and economy.

So far, Pan Am has flown only two classes on its Paris run: de luxe and economy. The forty de luxe passengers—round-trip fare, $909—sit in the forward end of the cabin in roomy seats, two abreast on both sides of the aisle and, in theory, are plied with liquor and a sumptuous meal catered by Maxim's of Paris. The seventy-one economy-class passengers—round-trip fare, $489.60—ride in the rear of the cabin in much smaller seats, three abreast on both sides of the aisle, and are fed sandwiches and coffee.

A partition with a folding door separates the two classes, and no passenger of one class may enter the compartment of another, except in emergency. Not wanting to arrive in Paris with a Maxim's-eye view of the trip, I chose to ride economy, with special dispensation, as a working journalist, to wander at will between the two compartments.

Our captain, Robert Weeks, along with the de luxe passengers, entered the elongated plane through the door near the nose. I walked aft and up a ramp which led into the rear cabin. Except for the seating arrangement, I might have been entering a swanky night club. The purser, dressed in white dinner jacket and cummerbund, stood by the door like a headwaiter. Soft music from special tapes flooded into the compartment through the loud-speaker system. The décor was strikingly modern: pastel grays and blues against white, with soft, indirect lighting.

There was considerable confusion in the compartment, however, since half a dozen of us were unable to locate our seats, and a dozen others wanted their coats hung up. The purser, trying to stem this confusion, was searching for a second purser or a stewardess to help out. "That's one of the troubles with these monsters," he grumbled. "They're so big you can't keep track of your people." The purser was making his second jet trip. Several of his assistants were making their first.

I climbed into my seat, which was outboard—next to one of the many small windows. There are nearly twice as many windows as seats and they are not aligned in the economy section. I had to lean forward to see out. (At night, flying above 30,000 feet, there is not much to see anyway.)

Over each seat there was an individual "service unit," containing a small NO SMOKING—FASTEN SEAT BELT sign, tiny loud-speaker, reading light, stewardess call-button and a compartment for the emergency oxygen-breathing apparatus, a spongelike device which is clamped over the nose and mouth in the unlikely event that the cabin pressurization fails. There is a blue plastic fold-down tray on the back of each seat, an item I was able to examine in microscopic detail when the man in front of me reclined his seat into my lap.

At 7:17 P.M. New York time, Captain Weeks shot a blast of compressed air into Number three engine, rolling the turbine. Within two minutes the three other engines were turning over, and without further ado the plane began to roll, guided by ground crewmen wearing special ear muffs as protection against engine noise. Inside, in the rear cabin, we needed no ear muffs, but could plainly hear a kind of deep-throated roar and high-pitched whistling of wind, all mixed together.

I recalled a memo written by a Pan Am executive: "Unfortunately," he said, "the jet *does* produce more sound than originally advertised, both inside and outside the aircraft. There is no sense in trying to disguise this obvious fact. Therefore, I would like to suggest to you that we may